Claims:

What is claimed is:

1. A method for controlling a manufacturing apparatus, the method comprising the steps of:

(a) identifying at least one input, the at least one input causing a change in at least two of a plurality of outputs;

(b) storing values of the identified inputs and corresponding empirical output values along with predicted output values, wherein the predicted output values are calculated based on, in part, the values of the identified inputs;

(c) calculating a set of transform coefficients by minimizing a score equation that is a function of, in part, differences between one or more of the empirical output values and their corresponding predicted output values, wherein the score equation is:

$$S_p = \sum_{i,k} W_{i,k} (y^{ik}_{actual} - y^{ik}_{predicted}(\vec{X}^{i\prime}(\vec{X}^i, \vec{P})))^2$$

where:

i – number of wafer;

k – number of output;

y_{actual} - an empirical output value;

$y_{predicted}$ - a predicted output value, as calculated based on transformed inputs for a particular wafer i ($\vec{X}^{i\prime}$)

$\vec{X}^{i\prime} = (X_1^{i\prime}, X_2^{i\prime}, X_3^{i\prime})$ is transformed input values in a vector format; $\vec{X}^{i} = (X_1^{i}, X_2^{i}, X_3^{i})$ for wafer *i* together with the transformation parameters $\vec{P}$, to thereby calculate an optimal value of $\vec{P}$; and

(d) calculating one or more input values for one or more desired output values based on, in part, the calculated set of transform coefficients.

2. The method of claim 1, further comprising the steps of:

collecting additional empirical data and corresponding input values;

calculating a new set of coefficients $\vec{P}_{new}$; and

using the new set of coefficients as the optimal value of $\vec{P}$.

3. The method of claim 1 further comprising the steps of:

collecting additional empirical data and corresponding input values;

calculating a new set of coefficients as

$\vec{P}_{new} \equiv \vec{P}_{previous} + K(\vec{P}_{optimum} - \vec{P}_{previous})$, wherein K < 1 and $\vec{P}_{previous}$ is a previously calculated optimal value of $\vec{P}$; and

using the new set of coefficients as the optimal value of $\vec{P}$.

4. A system for controlling a manufacturing apparatus, the system comprising:

(a) means for identifying at least one input, the at least one input causing a change in at least two of a plurality of outputs;

(b) a memory device configured to store values of the identified inputs and corresponding empirical output values along with predicted output values, wherein the predicted output values are calculated based on, in part, the values of the identified inputs;

(c) means for calculating a set of transform coefficients by minimizing a score equation that is a function of, in part, differences between one or more of the empirical output values and their corresponding predicted output values, wherein the score equation is:

$$S_p = \sum_{i,k} W_{i,k} (y^{ik}_{actual} - y^{ik}_{predicted}(\vec{X}^{i\prime}(\vec{X}^i, \vec{P})))^2$$

where:

i – number of wafer;

k – number of output;

y_{actual} - an empirical output value;

$y_{predicted}$ - a predicted output value, as calculated based on transformed inputs for a particular wafer i ($\vec{X}^{i\prime}$)

$\vec{X}^{i\prime} = (X^{i\prime}_1, X^{i\prime}_2, X^{i\prime}_3)$ is transformed input values in a vector format; $\vec{X}^i = (X^i_1, X^i_2, X^i_3)$ for wafer i together with the transformation parameters $\vec{P}$, to thereby calculate an optimal value of $\vec{P}$; and

(d) means for calculating one or more input values for one or more desired output values based on, in part, the calculated set of transform coefficients.

5. The system of claim 4, further comprising:

means for collecting additional empirical data and corresponding input values; and

means for calculating a new set of coefficients $\vec{P}_{new}$, wherein the new set of coefficients is defined as the optimal value of $\vec{P}$.

6. The system of claim 4, further comprising:

means for collecting additional empirical data and corresponding input values; and

means for calculating a new set of coefficients as

$\vec{P}_{new} \equiv \vec{P}_{previous} + K(\vec{P}_{optimum} - \vec{P}_{previous})$, wherein K < 1 and $\vec{P}_{previous}$ is a previously calculated optimal value of $\vec{P}$, wherein the new set of coefficients is defined as the optimal value of $\vec{P}$.

7. A computer readable medium for storing instructions being executed by one or more computers, the instructions directing the one or more computers for predicting output characteristics of a device produced by a manufacturing apparatus, the instructions comprising implementation of the steps of:

(a) identifying at least one input, the at least one input causing a change in at least two of a plurality of outputs;

(b) storing values of the identified inputs and corresponding empirical output values along with predicted output values, wherein the predicted output values are calculated based on, in part, the values of the identified inputs;

(c) calculating a set of transform coefficients by minimizing a score equation that is a function of, in part, differences between one or more of the empirical output values and their corresponding predicted output values, wherein the score equation is:

$$S_p = \sum_{i,k} W_{i,k} (y_{actual}^{ik} - y_{predicted}^{ik} (\vec{X}^{i\prime} (\vec{X}^{i}, \vec{P})))^2$$

where:

i – number of wafer;

k – number of output;

y_{actual} - an empirical output value;

$y_{predicted}$ - a predicted output value, as calculated based on transformed inputs for a particular wafer i ($\vec{X}^{i\prime}$)

$\vec{X}^{i\prime} = (X_1^{i\prime}, X_2^{i\prime}, X_3^{i\prime})$ is transformed input values in a vector format; $\vec{X}^{i} = (X_1^{i}, X_2^{i}, X_3^{i})$ for wafer i together with the transformation parameters $\vec{P}$, to thereby calculate an optimal value of $\vec{P}$; and

(d) calculating one or more input values for one or more desired output values based on, in part, the calculated set of transform coefficients.

8. The medium of claim 7, further comprising the steps of:

collecting additional empirical data and corresponding input values;

calculating a new set of coefficients $\vec{P}_{new}$; and

using the new set of coefficients as the optimal value of $\vec{P}$.

9. The medium of claim 7, further comprising the steps of:

collecting additional empirical data and corresponding input values;

calculating a new set of coefficients as

$\vec{P}_{new} \equiv \vec{P}_{previous} + K(\vec{P}_{optimum} - \vec{P}_{previous})$, wherein K < 1 and $\vec{P}_{previous}$ is a previously calculated optimal value of $\vec{P}$; and

using the new set of coefficients as the optimal value of $\vec{P}$.

10. A method for controlling a manufacturing apparatus, the method comprising the steps of:

(a) identifying at least one input that causes a change in at least two of a plurality of outputs;

(b) storing values of the identified inputs and corresponding empirical output values;

(c) calculating and storing predicted output values, based on, in part, the values of the identified inputs;

(d) calculating a set of transform coefficients by minimizing a score equation that is a function of, in part, differences between one or more of the empirical output values and their corresponding predicted output values; and

(e) calculating one or more input values for one or more desired output values based on, in part, the calculated set of transform coefficients.

11. The method of claim 10, wherein the score function is:

$$S_p = \sum_{i,k} W_{i,k} (y^{ik}_{actual} - y^{ik}_{predicted}(\vec{X}^{i\prime}(\vec{X}^i, \vec{P})))^2$$

where:

i – number of wafer;

k – number of output;

y_{actual} - an empirical output value;

$y_{predicted}$ - a predicted output value, as calculated based on transformed inputs for a particular wafer i ($\vec{X}^{i\prime}$)

$\vec{X}^{i\prime} = (X_1^{i\prime}, X_2^{i\prime}, X_3^{i\prime})$ is transformed input values in a vector format; $\vec{X}^i = (X_1^i, X_2^i, X_3^i)$ for wafer i together with the transformation parameters $\vec{P}$, to thereby calculate an optimal value of $\vec{P}$.

12. The method of claim 10, further comprising the steps of:

collecting additional empirical data and corresponding input values;

calculating a new set of coefficients $\vec{P}_{new}$; and

using the new set of coefficients as the optimal value of $\vec{P}$.

13. The method of claim 10 further comprising the steps of:

collecting additional empirical data and corresponding input values; and

calculating a new set of coefficients based on the additional empirical data.

14. The method of claim 13, further comprising

calculating the new set of coefficients using:

$\vec{P}_{new} \equiv \vec{P}_{previous} + K(\vec{P}_{optimum} - \vec{P}_{previous})$, wherein K < 1 and $\vec{P}_{previous}$ is a previously calculated optimal value of $\vec{P}$; and

using the new set of coefficients as the optimal value of $\vec{P}$.

15. A system for controlling a manufacturing apparatus, the system comprising:

(a) means for identifying at least one input that causes a change in at least two of a plurality of outputs;

(b) a memory device configured to store values of the identified inputs and corresponding empirical output values along with predicted output values, wherein the predicted output values are calculated based on, in part, the values of the identified inputs;

(c) means for calculating a set of transform coefficients by minimizing a score equation that is a function of, in part, differences between one or more of the empirical output values and their corresponding predicted output values; and

(d) means for calculating one or more input values for one or more desired output values based on, in part, the calculated set of transform coefficients.

16. The system of claim 15, wherein the score equation is:

$$S_p = \sum_{i,k} W_{i,k} (y^{ik}_{actual} - y^{ik}_{predicted}(\vec{X}^{i\prime}(\vec{X}^i, \vec{P})))^2$$

where:

i – number of wafer;

k – number of output;

y_{actual} - an empirical output value;

$y_{predicted}$ - a predicted output value, as calculated based on transformed inputs for a particular wafer i ($\vec{X}^{i\prime}$)

$\vec{X}^{i\prime} = (X_1^{i\prime}, X_2^{i\prime}, X_3^{i\prime})$ is transformed input values in a vector format; $\vec{X}^i = (X_1^i, X_2^i, X_3^i)$ for wafer i together with the transformation parameters $\vec{P}$, to thereby calculate an optimal value of $\vec{P}$.

17. The system of claim 15, further comprising:

means for collecting additional empirical data and corresponding input values; and

means for calculating a new set of coefficients $\vec{P}_{new}$, wherein the new set of coefficients is defined as the optimal value of $\vec{P}$.

18. The system of claim 15, further comprising:

means for collecting additional empirical data and corresponding input values; and

means for calculating a new set of coefficients based on the additional empirical data.

19. The system of claim 18, wherein the means for calculating is further configured to use the following equation in calculating the new of coefficients:

$\vec{P}_{new} \equiv \vec{P}_{previous} + K(\vec{P}_{optimum} - \vec{P}_{previous})$, wherein $K < 1$ and $\vec{P}_{previous}$ is a previously calculated optimal value of $\vec{P}$, wherein the new set of coefficients is defined as the optimal value of $\vec{P}$.

20. A computer readable medium for storing instructions being executed by one or more computers, the instructions directing the one or more computers for predicting output characteristics of a device produced by a manufacturing apparatus, the instructions comprising implementation of the steps of:

(a) identifying at least one input that causes a change in at least two of a plurality of outputs;

(b) storing values of the identified inputs and corresponding empirical output values;

(c) calculating and storing predicted output values, based on, in part, the values of the identified inputs;

(d) calculating a set of transform coefficients by minimizing a score equation that is a function of, in part, differences between one or more of the empirical output values and their corresponding predicted output values; and

(e) calculating one or more input values for one or more desired output values based on, in part, the calculated set of transform coefficients.

21. The method of claim 20, wherein the score function is:

$$S_p = \sum_{i,k} W_{i,k} (y^{ik}_{actual} - y^{ik}_{predicted}(\vec{X}^{i\prime}(\vec{X}^i, \vec{P})))^2$$

where:

i – number of wafer;

k – number of output;

y_{actual} - an empirical output value;

$y_{predicted}$ - a predicted output value, as calculated based on transformed inputs for a particular wafer i ($\vec{X}^{i\prime}$)

$\vec{X}' = (X_1', X_2', X_3')$ is transformed input values in a vector format; $\vec{X}^i = (X_1^i, X_2^i, X_3^i)$ for wafer *i* together with the transformation parameters $\vec{P}$, to thereby calculate an optimal value of $\vec{P}$.

22. The medium of claim 20, further comprising the steps of:

collecting additional empirical data and corresponding input values;

calculating a new set of coefficients $\vec{P}_{new}$; and

using the new set of coefficients as the optimal value of $\vec{P}$.

23. The medium of claim 20, further comprising the steps of:

collecting additional empirical data and corresponding input values;

calculating a new set of coefficients as

$\vec{P}_{new} \equiv \vec{P}_{previous} + K(\vec{P}_{optimum} - \vec{P}_{previous})$, wherein K < 1 and $\vec{P}_{previous}$ is a previously calculated optimal value of $\vec{P}$; and

using the new set of coefficients as the optimal value of $\vec{P}$.